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Forming Condition and Geology Prediction Techniques of Deep Clastic Reservoirs

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1 Introduction

As new exploration domain for oil and gas, reservoirs with low porosity and low permeability have become a hotspot in recent years (Li Daopin, 1997).With the improvement of technology, low porosity and low permeability reservoirs are commonly found in most sedimentary basins, which makes this kind of reservoir more and more meaningful. The success of reservoir prediction depends mainly on finding reservoirs with sufficient porosity and permeability (Worden et al., 2000; Taylor et al., 2010). Reservoirs with low porosity and low permeability are characterized by diagenesis diversity, strong heterogeneity and complex fractures (Li Daopin, 1997; Yang Renchao, Fan Aiping, A. J. et al., 2014). Thus there is a great challenge to identify position of favorable reservoirs with low porosity and low permeability by traditional exploration means.

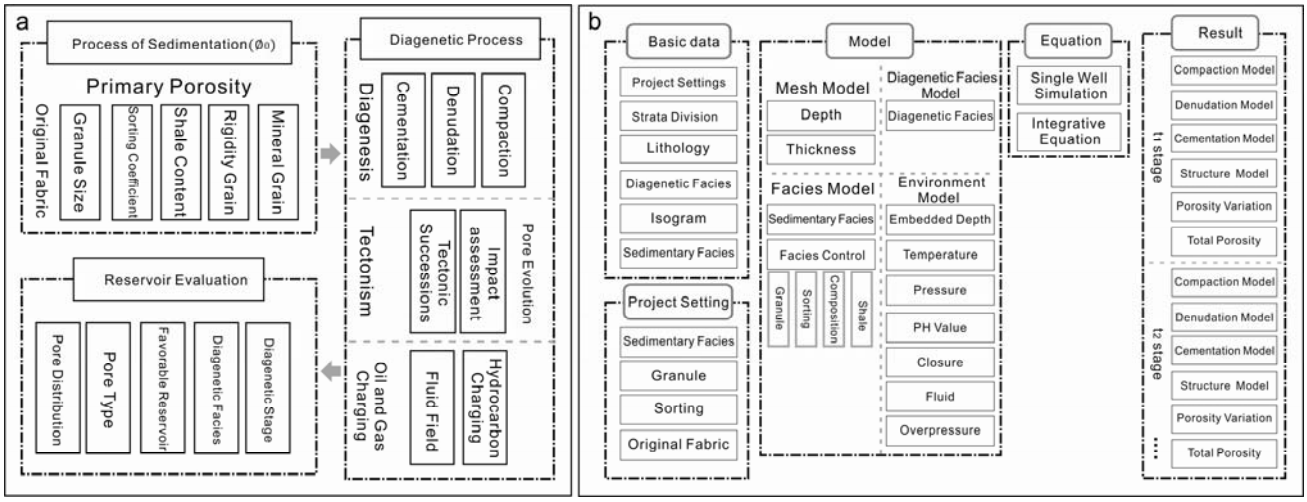

Fig. 1. General thought of Diagenetic Modeling in Clastic Rock.(a), Based on process mechanism, three aspects are discussed in our research, including process of sedimentation, diagenetic process and reservoir evaluation. Numerical methods of model such as diagenesis method, tectonism and oil and gas charging are established to simulate the evolution of porosity change in burial history. (b),Function Modules of Computer Simulator

Sedimentary facies and diagenesis are the main factors controlling reservoirs pore evolution, and sedimentary facies controls porosity evolution at shallow burial depth while diagenesis affects pore evolution at deep burial depth (Meng Yuanlin, 2008; Zou Caineng et al., 2009). Diagenesis is a necessary process for the development and formation of all reservoirs, which ultimately determines the reservoir physical property. This is particularly true for reservoir with low porosity and low permeability (Wilson M.D., Stanton P.T., 1994; Li Z, Chen JS, Guan P., 2006; Zhang Shaonan, 2008).

Numerical simulation of diagenesis process is to select diagenetic parameters and simulate its temporal and spatial distribution, and then to evaluate favorable reservoir by simplified model according to actual needs (Zhang Jinliang, et al., 2013). Our research was to study reservoirs with low porosity and low permeability

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formation mechanism in burial process which is the basic principle of science. It can provide a good way for reservoir prediction in high diagenetic stage (Fig. 1).

2 Sedimentation and Diagenesis and Effects on Reservoirs

The porosity and permeability have close relation with the original composition and structure, which is controlled by sedimentary facies (Abdullah A. Z., Howard D. J., 2013; Jian Wang, Yingchang Cao, et al., 2017). It is found that sedimentation is a basic factor for generating low permeability reservoirs, and the strong compaction and cementation are the key factors for forming low porosity and low permeability reservoirs.

The effect of compaction, cementation and dissolution during diagenesis has been discussed by different scholars (Rashid D.D., 1985; Dacid B.B.,2001; Theodore T.M.1996; Craig E.M.,1994).

3 Reservoir Prediction

At present, the numerical simulation methods fall into two major categories. The first category is based on physical or chemical model, which use single factor model to simulate the effect of diagenesis on pores while the other one only considers the comprehensive results of diagenesis on pores, but not caring about concrete diagenesis (Zhang Jinliang, et al., 2013; Jian Wang, Yingchang Cao, et al., 2017). In our study we firstly simulate the effect of different diagenesis on pores in burial history, and then a synthetic equation model was established, which can be used to compute the porosity of clastic reservoirs, particularly on reservoirs with low porosity and low permeability.

4 Conclusions

Based on burial process, a new reservoir diagenetic facies and porosity prediction method is presented. The method is primarily based on the identification of sedimentary facies, burial history, thermal history, pressure history, fluid history, diagenetic facies of individual well, which are derived from cores, well log data and seismic data.

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References

Li Daopin,1997. The development of the low permeability sandstone oil field. *Petroleum Industry Press* (in Chinese).

Worden, R.H., Mayall, M., and Evans, I.J., 2000. The effect of ductile-lithic sand grains and quartz cement on porosity and permeability in Oligocene and lower Miocene clastics, South China Sea: prediction of reservoir quality. *AAPG Bull*. 84, 345 –359.

Taylor, T.R., Giles, M.R., Hathon, L.A., Diggs, T.N., Braunsdorf, N.R., Birbiglia, G.V., 2010. Sandstone diagenesis and reservoir quality prediction: models, myths, and reality. *AAPG Bull*. 94, 1093–1132.

Yang Renchao1, Fan Aiping, A. J. van LOON, Han Zuozhen and Wang Xiuping, 2014. Depositional and diagenetic controls on sandstone reservoirs with low porosity and low permeability in the Eastern Sulige Gas Field, China. *Acta Geologica Sinica (English Edition).* 88(5) pp.1513–1534.

Meng Yuanlin, Jiang Wenya, Liu Dela, Niu Jiayu Sun Hong bing, Xiao Lihua, Si Shangming, Xiu Hongwen., 2008. Reservoir porosity prediction and its evolving history modeling: a case of Shuang Qing region in the Liaohe west depression. *Acta Geologica Sinica.* 26(5):780-788.

Zou Caineng, Tao Shizhen, Zhang Xiangxiang, He Dongbo, Zhou Chuanmin, and Gao Xiaohui, 2009. Geologic characteristics, controlling factors and hydrocarbon accumulation mechanisms of China’s Large Gas Provinces of low porosity and permeability. *Science in China Series D: Earth Sciences.* 52(8)1068-1090.

Wilson M.D. and Stanton P.T.,1994. Diagenetic Mechanisms of porosity and permeability reduction and enhancement. *SEPMShort Course.*

Li Z, Chen JS and Guan P., 2006. Scientific problems and frontiers of sedimentary diagenesis research in oil-gas bearing basins. *Acta Petrologica Sinica*, 22(8):2113-2122 (in Chinese).

Zhang Shaonan, 2008. Tight sandstone gas reservoirs: their origin and discussion. *Oil & Gas Geology*.29(1):1-11(in Chinese).

Zhang Jinliang, Zhang Penghui, Xie Jun, etal, 2013. Diagenesis of clastic reservoirs: Advances and prospects. *Advances in Earth Science*, 28(9) : 957-967(in Chinese).

Jian Wang, Yingchang Cao, Keyu Liu, Jie Liu and Muhammad Kashif, 2017. Identification of sedimentary-diagenetic facies and reservoir porosity and permeability prediction: An example from the Eocene beach-bar sandstone in the Dongying Depression, ChinaOriginal Research Article. *Marine and Petroleum Geology*, 82: 69-84.

Abdullah A. Z., Howard D. J., Christopher A.L., Jackson and Felix Tongkul, 2013. Sedimentary facies analysis and depositional model of the Palaeogene West Crocker submarine fan system, NW Borneo Original Research Article. *Journal of Asian Earth Sciences*, 76(25): 283-300.